MOTOROLA INC. COMMUNICATIONS DIVISION • **INSTRUCTION MANUAL**

MOTOROLA PRECISION INSTRUMENT PRODUCTS

Frequency Standard

MODEL S1076AR

68P81030A20-A

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MOTOROLA

1010 FREQUENCY STANDARD

MODEL S1076AR

CE2286-M36

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Issue - A

GUARANTEED PERFORMANCE SPECIFICATIONS

OUTPUT FREQUENCIES	1 mc and 100 kc at 1 volt rms sine wave into 50 ohms
STABILITY ΔF (MAX.) versus: F Input Voltage Change ±10% Load Resistance Change ±10% Ambient Temperature 25°C ±25°C Ambient Temperature 25°C ±5°C	 Less than $\pm 1 \times 10^{-9}$ Less than $\pm 2 \times 10^{-10}$ Less than $\pm 1 \times 10^{-8}$ total Less than $\pm 2 \times 10^{-9}$
TIME 24 hr.: Short term (10 sec. avg. time):	Less than $\pm 1 \times 10^{-9}$ Less than $\pm 5 \times 10^{-10}$
FREQUENCY ADJUST RANGE Coarse: Fine:	$\pm 2 \times 10^{-6}$ minimum (internal tuning tool adjustment) 1×10^{-7} total (front panel screwdriver adjustment)
DISTORTION	Less than 2% into rated load
INPUT VOLTAGE	115 vac ±10% or 230 vac ±10% 50-60 cps
POWER CONSUMPTION	Less than 10 watts at room temperature
CIRCUITRY	Proportional control oven, zener regulation, silicon transistors
OPERATING TEMPERATURE RANGE	-20°C to +50°C
OUTPUT CONNECTORS	Standard BNC type
SIZE AND WEIGHT	19" wide x 3-1/2" high x 4-1/2" deep. Approximately 5-1/2 lbs.

SPECIFICATIONS SUBJECT TO CHANGE WITHOUT NOTICE

FOREWORD

CLAIM FOR DAMAGE IN SHIPMENT

If any damage to the shipping container is apparent upon receipt, the delivering driver should be requested to note such damage on all copies of the freight bill. This is for your protection should the material have sustained damage.

The equipment should be unpacked immediately, examined for damage and tested. If it fails to operate properly, or is damaged in any way, a claim should be filed with the carrier. The claim should be filed within forty-eight hours after receipt, if possible, or during a period not to exceed fifteen days.

A full report of such damage should be obtained from the claim investigator, who will call upon you. For the purpose of this report, the shipping container and all packing materials should be retained for the investigator to examine.

The investigator's report should then be forwarded to:

Motorola Communications &
Electronics, Inc.
Precision Frequency Products
Department
4501 West Augusta Boulevard
Chicago, Illinois 60651

Include model number and serial number when referring to the instrument for any reason.

Arrangements for repair or replacement will be made and you will be advised of the disposition of the instrument.

REPAIR AND/OR RECALIBRATION

If desired the instrument may be returned to:

Motorola Communications &
Electronics, Inc.
Precision Frequency Products
Department
4501 West Augusta Boulevard
Chicago, Illinois 60651

for repair and/or recalibration. Before shipping the instrument notify the Precision Frequency Products Department at the above address of the service required. Refer to the instrument by model number and serial number. On receipt of this information, you will be informed of shipping instructions. If requested, an estimate of the charges will be made before work begins, provided the instrument is not covered by the warranty.

SHIPPING

The instrument should be surrounded by two or three inches of excelsior or similar shock absorbing material and then packed in a strong exterior container. It should be shipped via truck, railway express, air freight or air express.

WARRANTY

Motorola instrument equipment other than tubes, fuses, vibrators and batteries is guaranteed by Motorola, for a period of one year after delivery to the original purchaser, against defects in design, material, and workmanship. Our liability under this warranty is limited to servicing or adjusting any instrument returned to the factory Service Department for that purpose and to replace any defective parts thereof.

Tubes and vibrators carry their own standard manufacturer's warranty of 90 days or 1000 hours, whichever first occurs.

This warranty is effective for one year after delivery to the original purchaser when the instrument is returned, transportation charges prepaid by the original purchaser, and when upon our examination it is disclosed to our satisfaction to be defective. If the fault has been caused by misuse or abnormal conditions of operation, repairs will be billed at the net price of necessary parts and a service charge at Motorola's then prevailing labor rate. In this case, an estimate will be submitted before the work is started.

This warranty is in lieu of all other warranties, expressed or implied and all other obligations or liabilities on Motorola's part.

If any fault develops, the following steps should be taken:

1. Notify us at the following address:

   Motorola Communications & Electronics, Inc.
   Precision Frequency Products Department
   4501 West Augusta Boulevard
   Chicago, Illinois 60651

   Give full details of the difficulty, and include model number and serial number. On receipt of this information, we will give you service data or shipping instructions.

2. On receipt of shipping instructions, forward the instrument prepaid to the above address or to the authorized repair station indicated on the instructions. If requested, an estimate of the charges will be made before the work begins, provided the instrument is not covered by the warranty.

1. INTRODUCTION

The Model S1076AR Frequency Standard is a rack mounted, all solid-state (silicon) instrument that provides highly stable 1 mc and 100 kc output signals. Stability is maintained over a wide range of ambient temperatures by enclosing the crystal in a precision oven.

2. DESCRIPTION

The unit consists of a single oven high stability oscillator, a 1 mc isolation amplifier, a 1 mc to 100 kc divider circuit and a power supply.

The basic accuracy of the unit is determined by a precise, glass enclosed crystal oven which is maintained accurately to a given temperature in the 80°C region. Provision is made for adjusting the internal crystal frequency without removing the unit from its case.

A glass piston capacitor is used for the fine frequency adjustment of the oscillator and a variable inductor is used for the coarse frequency adjustment. The inductor is housed inside the oven and has a screwdriver adjustment. The capacitor is rigidly mounted to the front panel and is tuned by a screwdriver adjustment on the front panel. The fine frequency tuning range is approximately 1 part in 10^7.

A voltage regulator in the power supply insures stable operating voltage. An overload protection circuit prevents momentary short circuits from causing damage to the semiconductors in the power supply. A red lamp on the front panel provides an indication that a-c power is applied to the unit.

3. INSTALLATION

a. 115 VAC Operation

Connect the a-c line cord to a 115-volt, 50-60 cycle, a-c convenience outlet. The red indicator lamp on the front panel will light. The use of an exclusive 24-hour a-c line will protect the unit from accidental shutdown during non-working hours and from power failures resulting from temporary overloads by other equipment.

b. 230 VAC Operation

Unless specifically ordered for 230 v a-c operation, the unit is shipped from the factory for 115 v a-c operation.

CAUTION

Before attempting 230 v a-c operation, the transformer primary circuit must be wired as shown on Schematic Diagram 63D81030A21 for 230 v a-c operation.

c. Output Connections

Separate BNC type connectors are provided on the front panel for the 1 mc and 100 kc outputs. The unit is capable of a 1-volt output into a 50-ohm resistive load.

4. THEORY OF OPERATION

a. General

Refer to Block Diagram 69C81030A22 and Schematic Diagram 63E81030A21.

A 3 mc glass enclosed crystal was selected as being well suited to provide good stability and low aging over a long period of time. A transistor oscillator employing stabilized circuitry and low drive level for the precision crystal is used to insure the utmost in performance. An isolation amplifier provides isolation of the oscillator circuitry from external load effects. A high-gain, proportional-control oven circuit maintains the crystal at a predetermined temperature. A fail-safe 3:1 divider circuit, controlled by the 3 mc crystal, provides the 1 mc oscillator output.

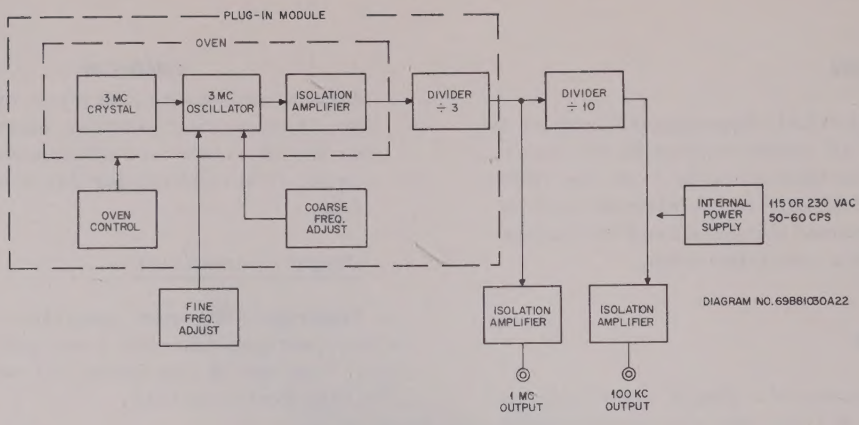
A fail-safe divider circuit produces the desired 100 kc output frequency. A power supply incorporating a stable, solid state regulator is used to eliminate the effects of voltage variations on the output frequencies.

b. Oscillator

Oscillator transistor parameters are relatively temperature and age insensitive. It operates at low power levels with low noise, since noise contributes to short-term instabilities. Furthermore, the transistor has a high ratio of maximum frequency to operating frequency to insure little phase shift through it. Changes in phase shift due to aging and other variations, consequently, are also small.

c. Output Signal Circuits

A 1 mc output from the oscillator is coupled to the isolation amplifier circuit of Q101. Capacitive taps in the tuned circuit of this transistor apply the signal to the 1 mc output connector at the front of the frequency standard.



S1076AR Frequency Standard Block Diagram

The 100 kc output signal is derived in the 1 mc to 100 kc divider circuit. A 1 mc input signal from the oscillator is applied to the isolation amplifier circuit of Q201. The amplified 1 mc signal is then fed from the capacitive tap in the tank circuit of Q201 to the base of Q202 to provide gating of locked oscillator Q203. The tank circuit of Q203 is tuned to 100 kc. The emitter of Q203 provides a 100 kc signal to the base of Q204 which is the 100 kc output isolation amplifier. The signal is then coupled from the collector circuit of Q204 to the 100 kc output connector on the front panel. In the absence of a 1 mc input signal, locked oscillator Q203 is biased to cutoff for fail-safe operation.

d. Power Supply

The frequency standard operates from a 50 to 60 cps, single-phase primary source of 115/230 volts, a-c. The power supply delivers 23 v d-c from an electronic regulator with a capacity sufficient to operate the unit.

Transformer T1 supplies primary a-c to the bridge rectifier consisting of CR1, CR2, CR3 and CR4. Approximately 40 v d-c is impressed across filter capacitor C3 and applied to the regulator circuits.

Transistor Q1 functions as a series regulator, and Q2 senses and regulates the output voltage. Zener diode CR5, via Q2, establishes a fixed voltage reference level. Q2 utilizes this reference level at its emitter to sense power supply output voltage changes appearing across R4 and R5. DC changes at the base of Q2 are therefore amplified and, with Q2 collector connected to the base of Q1, change the base voltage which results in a voltage change at the emitter of Q1.

Momentary short circuits across the power supply output will not damage the unit. During a short circuit, load current is limited by design of the regulator to 1 ampere. In addition, fuse F2 may open. Should the short persist, fuse F2 will open and remove d-c voltage input from the unit.

LINE fuse F1 is located at the rear and is accessible from outside the unit. Fuse F2 is located on the power supply sub-chassis.

5. MAINTENANCE

a. General

This instrument should be serviced by personnel qualified in maintaining laboratory test equipment. It is an accurate, sensitive device and should be treated as such. When qualified personnel or adequate test equipment are not available, the equipment should be returned to the factory for service or recalibration. Refer to the FOREWORD for detailed instructions.

b. Dust Cover Removal

To gain access to the interior of the unit, remove two screws from either end of the unit and lift the cover toward the rear.

c. Calibration and Adjustments

Periodic calibration adjustments against a known frequency standard should be made. Should the instrument fail to respond to the adjustments in the manner described, the possibility of a malfunction in the high stability oscillator unit is indicated. Do not attempt to service the unit. It must be returned to the factory for repair.

69B81030A22-A

For fine frequency adjustment, the FREQUENCY ADJUST screwdriver adjustment located on the front panel provides a frequency range of approximately 1 part in 10^7. Clockwise rotation produces decreasing frequency. Mechanical stops are provided at either end of the adjustment, but care should be exercised to prevent damage to the capacitor stop mechanism. If further change of frequency is desired, the COARSE adjust control must be used.

For coarse frequency adjustment, the COARSE frequency adjustment screwdriver control is used. This control is accessible by removing the unit dust cover. Before adjusting this control, the fine FREQUENCY ADJUST control should be rotated two or three turns from the full counterclockwise position if the oscillator was aging upward, or two or three turns from the full clockwise position if the oscillator was aging downward. The COARSE frequency adjustment is made by inserting the small blade of the tuning tool provided into the hole located at the top of the plug-in oscillator module. Rotation of the control in the counterclockwise direction increases frequency; rotation in the clockwise direction decreases frequency.

d. Power Supply Test

The power supply maintains an output voltage of approximately 23 volts to within ±0.5 volt for input voltages of 115/230 v a-c ±10%. If a component has been replaced, it is necessary to check the voltage regulation before returning the unit to service. To do this, vary the input voltage with a "Variac" between 105 and 130 v (210 and 260 v if nominal voltage is 230 v) a-c, and check the output voltage of the power supply with a voltmeter. If proper regulation is taking place, the output voltage will not vary more than ±0.5 volt.

e. General Alignment Considerations

The frequency standard requires very little maintenance. Transistors, being inherently reliable devices, do not normally require replacement for the life of the instrument. Should it become apparent that realignment is necessary, use the procedure outlined in this section.

Test equipment for this purpose should be of laboratory quality and subject to scheduled preventive maintenance and calibration.

f. 1 MC Isolation Amplifier Alignment Procedure
(Refer to Circuit Board Detail EPD-10871)

(1) Connect a 50-ohm resistive load to the 1 mc output connector.

(2) Connect the vertical input of an oscilloscope to the 1 mc output connector. Trigger the oscilloscope internally.

(3) Adjust C103 for a maximum undistorted waveform on the oscilloscope. The output voltage should be at least 1.0 volt, rms.

g. 1 MC to 100 KC Divider Alignment Procedure
(Refer to Circuit Board Detail EPD-10872)

(1) Connect a 50-ohm resistive load to the 100 kc output connector.

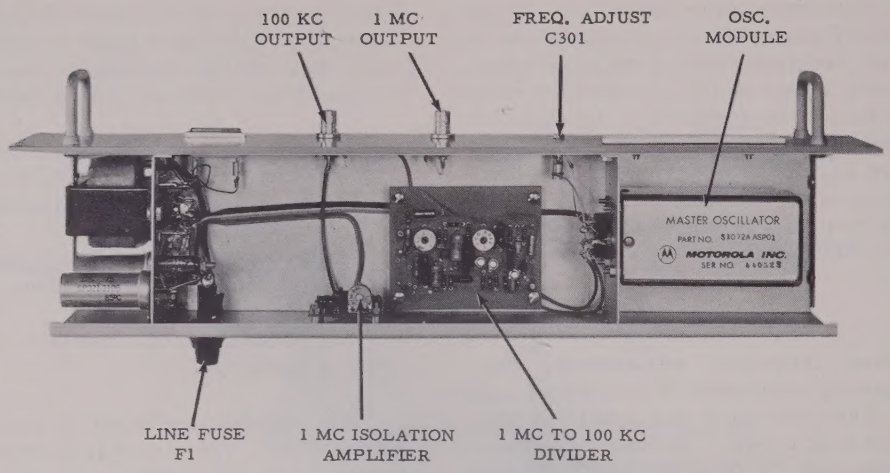
(2) Connect the oscilloscope horizontal external sweep to the 50-ohm load and the vertical sweep (input) to the 1 mc output connector.

(3) Adjust the slug of L202 for a 10:1 Lissajous figure. If not enough output signal is obtained to produce a usable Lissajous figure, the slug of L203 may be adjusted.

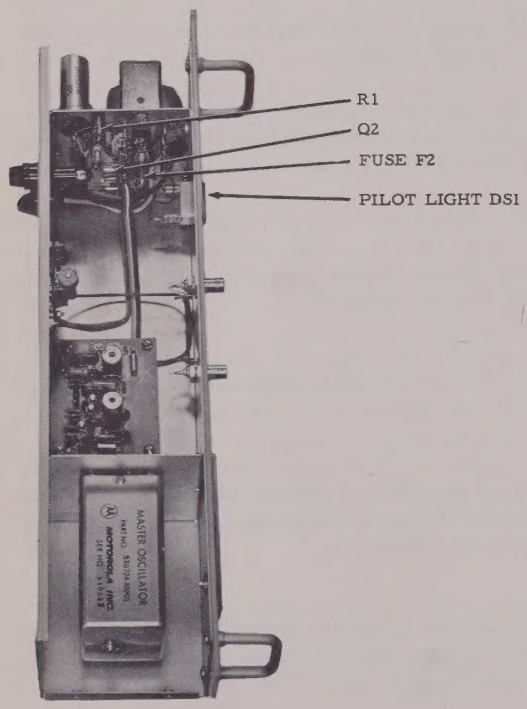
(4) Repeat step (3) until the slugs of L202 and L203 are adjusted for optimum operation.

(5) Connect the vertical input of the oscilloscope to the 100 kc output connector. Trigger the oscilloscope internally.

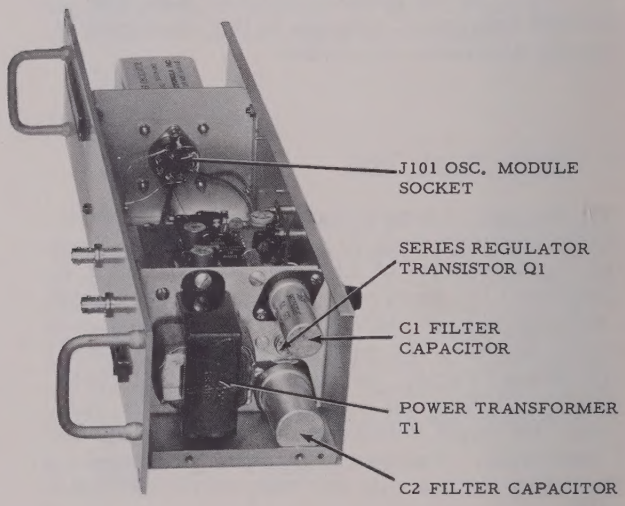
(6) Adjust L203 for a maximum undistorted waveform on the oscilloscope. The output voltage should be at least 1.0 volt, rms.



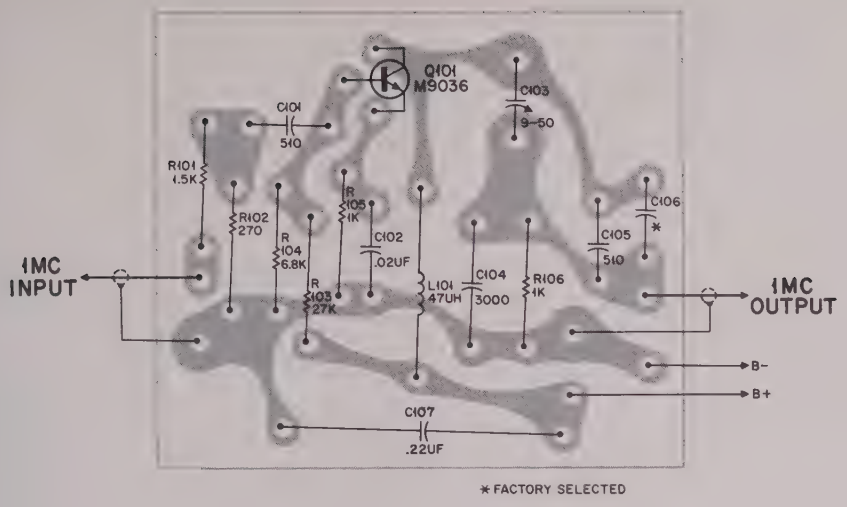
Parts Location Detail,
Top View



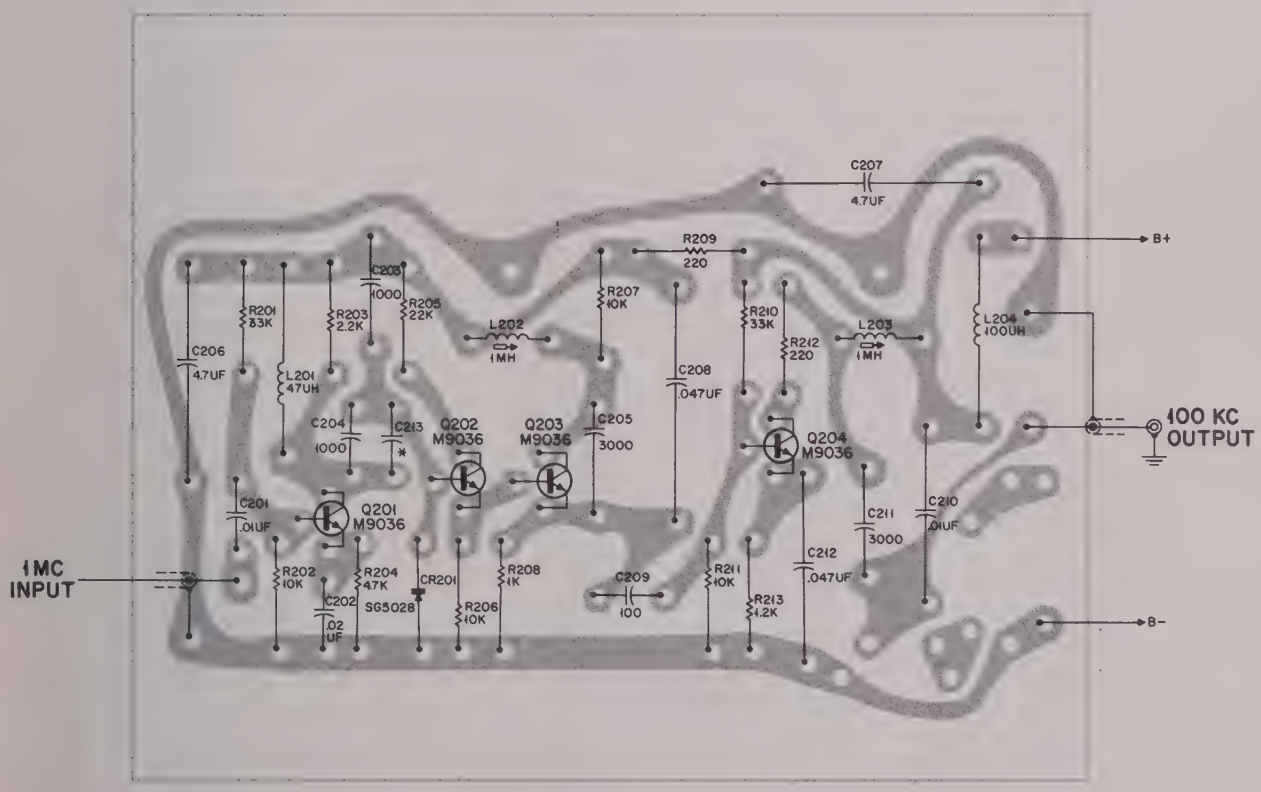
Parts Location Detail
View From Top Left



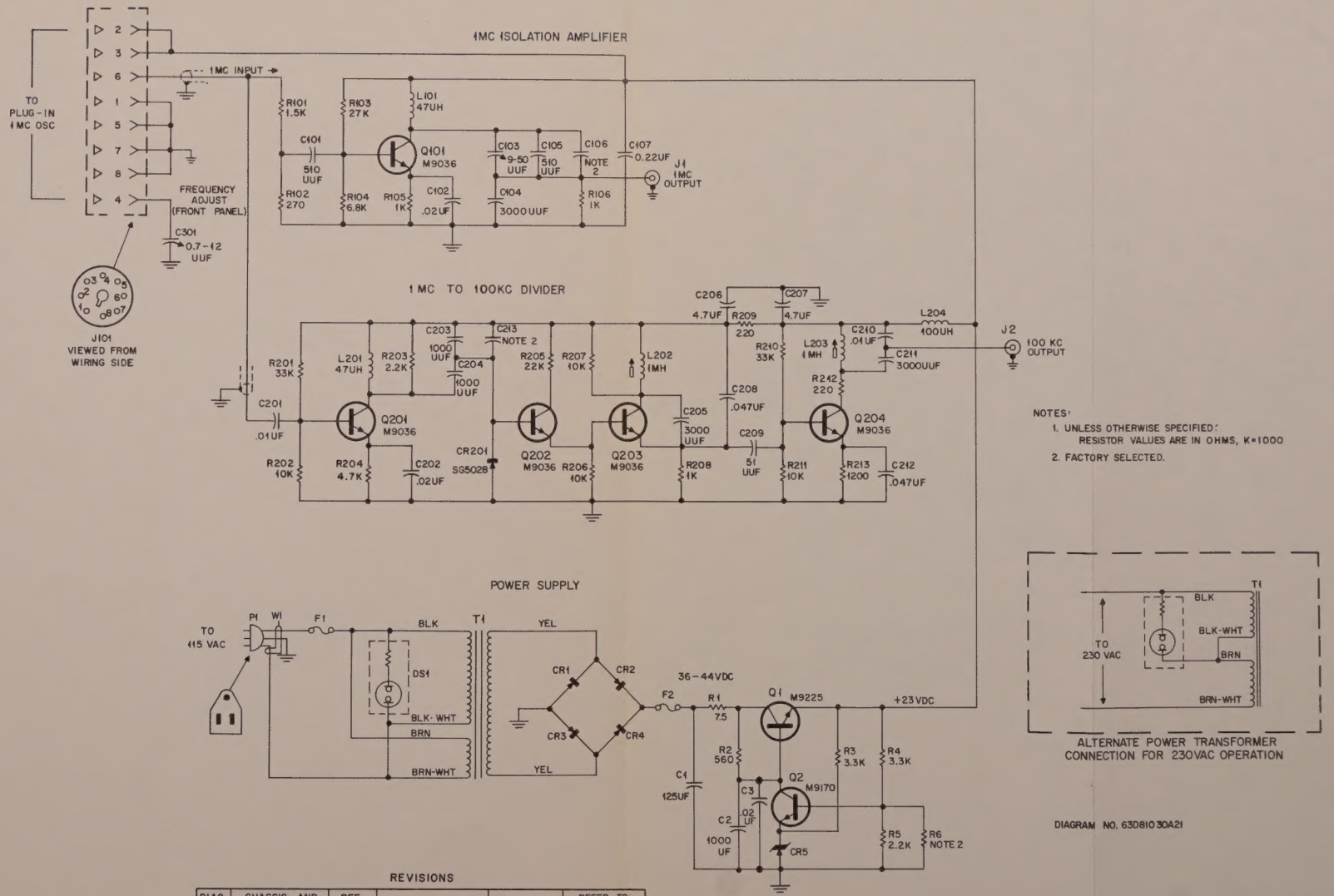
Parts Location Detail,
View From Top Right



1 MC Isolation Amplifier
Circuit Board Detail, EPD-10871-O



1 MC to 100 KC Divider
Circuit Board Detail, EPD-10872-O



REVISIONS

DIAG. ISSUE	CHASSIS AND SUFFIX NO.	REF. SYMBOL	CHANGE	LOCATION	REFER TO CIRCUIT BOARD
A		F2	WAS 65R898635, 3/4 AMP, 250 V	PARTS LIST	
		Q1	WAS 40250RCA		

Model S1076AR Frequency Standard
Schematic Diagram
Motorola No. 63D81030A21-A